Lesson: The Water Cycle (Middle School Grades 6-8) -adapted by Eresha Kissoon

Learning Goals

1. Students will build a model to simulate parts of the water cycle.
2. Students will be able to recognize and explain the essential elements of the water cycle.

Alignment to National Science Education Standards

- Unifying Concepts and Processes, Grades K to 12, pg.117: "Models are tentative schemes or structures that correspond to real objects, events, or classes of events and that have explanatory power."
- Earth and Space Science, Grades 5 to 8, Structure of the Earth System, pg.160, Item #6: "Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soils, and in rocks underground.

Background Content

All of the Earth's water (70% of the Earth's surface) goes through a cycle in which the water changes its locations or physical state through different processes. Water can be found in all three states of matter during the cycle: solid (ice caps), liquid (lakes), and gas (water vapor).

There are five processes by which water moves through the cycle. Water in oceans and lakes evaporates into the air. This phase change occurs when heat is added to the liquid water. Cool air in the atmosphere causes this water vapor to condense into a cloud. This occurs when heat is taken away from the water vapor. If the water vapor condenses further, precipitation from the cloud falls to the ground as rain, sleet, hail, or snow. Precipitation in the form of snow or ice occurs when the liquid water condenses down into the solid state. The water on the ground percolates through the soil and plants absorb some. As the plants go through photosynthesis (converting sunlight, water and carbon dioxide for their food), they absorb water from the soil and release some of it back into the air through transpiration. The water that is not absorbed by the plants is runoff. It runs back into rivers, which flow into ponds, lakes, or oceans where it evaporates back into the atmosphere. The cycle repeats. These patterns of change can vary, but the cycle occurs continuously. Water has been cycling by means of these processes since time began.

Vocabulary

Evaporation	Condensation
Precipitation	Photosynthesis
Transpiration	Percolation

Materials:

- 3 two-liter bottles with caps
- a drill with a ¼" drill bit
- Cotton string
- Empty film canister or extra bottle caps
- Soil
- Lima beans or grass seed
- Ice
- Water
- 200ml Beaker
- Scissors
- Ruler with cm markings

Lesson Outline:

Introduction to water cycle

a. Students complete pre-assessment handout with vocabulary words to assess current knowledge.
b. Project water cycle web onto smartboard. Solicit information through a discussion with students about how they think the water cycle works. Have students go up to the smartboard and record.

Procedure-Building water cycle model

a. Demo-Show students a completed model. Review procedure.
b. Students work in pairs to gather supplies and build model following procedure below. See student handout.

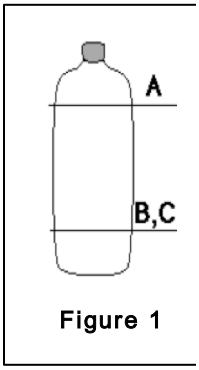
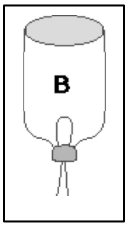


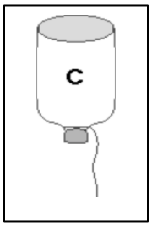
Figure 1

1. Remove labels from bottles by filling them with very warm water to warm the glue on the label.

2. Cut one bottle (Bottle A) just below the upper curve or the shoulder of the bottle. See Figure 1.

3. Cut the other two bottles (Bottle B and Bottle C) just above the lower curve of the hips of the bottle. See Figure 1.

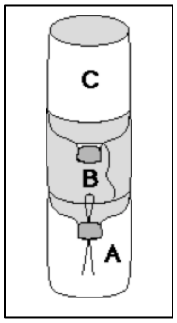




4. Drill a hole in one of the three bottle caps.

5. Place the cap with hole on Bottle B.

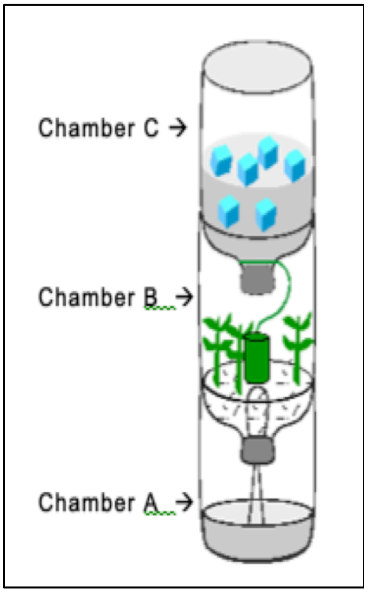
6. Cut a 30-40cm length of string. Fold the string in half and insert the folded end through the cap hole to make a loop inside. Leave at least 5cm of each end of the string hanging down from the cap.



7. Cut a 20-30cm length of string. Tie it around the neck of Bottle C so one end hangs down 5-7cm.

8. Wet the strings thoroughly.
   a. Assemble the column: B inserts into A; C inserts into B. These parts of your model will be referred to as “chambers” for the rest of the activity.

9. Fill chamber B with enough moist soil to cover the loop of string (about 1 cup). The string should run up into the soil and not be pressed against the side of the column.



10. Plant 3-5 lima beans (or sprinkle grass seed) in the soil around the sides of chamber B.

11. Place the film canister (or left over bottle cap) on top of the soil at the center of chamber B so that the string tied to the neck of chamber C hangs into it. If the film canister will not fit between the chamber and the soil, trim it with scissors. This is your rain collector.

12. Add 200ml of water into chamber A. This chamber will be the ground water of the cycle.

13. Add 150ml (2/3 cup) of water into capped chamber A. Add ice. This chamber will be the water source for the cycle.

14. Assemble the model and place where it can receive light for growth.

15. Work with a partner to complete Activity questions. Write a hypothesis that explains what you think will

Wrap-up

1. Review student activity questions. Add background content. Students record in science journal.
2. Students share their predictions.
3. Explain the data collection table.
4. Over a three-day period, teams complete hypothesis and observation charts. Students may also sketch observations in journal. On day four, students communicate how the water cycle works using lesson vocabulary, data collected and observations in written form and verbally.
5. Post Assessment-Students complete vocabulary handout to assess current knowledge.

Activity Questions

1. What do these 3 parts of the diagram represent?
    a. Water and ice in chamber A _____
    b. Film canister in chamber B _____
    c. Water in chamber C _____
2. Define the following processes
    a. Evaporation _____
    b. Condensation _____
    c. Precipitation _____
    d. Photosynthesis _____
    e. Transpiration _____
    f. Percolation
3. What percentage of the Earth's surface in covered in water? ____%
4. The water cycle is also called the _____ cycle.

Date	Hypothesis
Day 1	Chamber A- Chamber B- Chamber C-
Day 2	Chamber A- Chamber B- Chamber C-
Day 3	Chamber A- Chamber B- Chamber C-

Date	Observation	Chamber A	Chamber B	Chamber C
Day 1	Condensation (approx. % of coverage)			
	Plant growth (how many sprouts?)			
	Approximate Water in Rain Gauge (cm)			
	Water Level (cm)			
Day 2	Condensation (approx. % of coverage)			
	Plant growth (how many sprouts?)			
	Approximate Water in Rain Gauge (cm)			
	Water Level (cm)			
Day 3	Condensation (approx. % of coverage)			
	Plant growth (how many sprouts?)			
	Approximate Water in Rain Gauge (cm)			
	Water Level (cm)			

Rubric: Building Water Cycle Model

Category	4	3	2	1
Collection of Data	Data was collected several times. It was summarized, independently, in a way that clearly describes what was discovered.	Data was collected more than one time. It was summarized, independently, in a way that clearly describes what was discovered.	Data was collected more than one time. Adult assistance was needed to clearly summarize what was discovered.	Data was collected only once and adult assistance was needed to clearly summarize what was discovered.
Generating Hypotheses	Independently developed a hypothesis that is well substantiated by a literature review and observation of similar phenomena.	Independently developed a hypothesis somewhat substantiated by a literature review and observation of similar phenomena.	Independently developed a hypothesis somewhat substantiated by a literature review or observation of similar phenomena.	Needed adult assistance to develop a hypothesis or to do a basic literature.
Making sense of data/observations	Student provided a detailed conclusion clearly based on the data and related to previous research findings and the hypothesis statement.	Student provided a somewhat detailed conclusion clearly based on the data and related to the hypothesis statement.	Student provided a conclusion with some reference to the data and the hypothesis statement.	No conclusion was apparent OR important details were overlooked.
Collaboration	Almost always listens to, shares with, and supports the efforts of others. Tries to keep people working well together.	Usually listens to, shares, with, and supports the efforts of others. Does not cause "waves" in the group.	Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member.	Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player.
Conceptual Understanding	Ready grasp of all science concepts.	Fairly sure grip on all science concepts.	Seems to understand most science concepts but occasionally shares misconceptions.	Clearly does not understand the science concepts in this unit.

References

http://newyorkscienceteacher.com

"The Water Cycle." *Activity 4 Teacher Guide:*. N.p., n.d. Web. 10 July 2012. <http://www.ucar.edu/learn/1_1_2_4t.htm>.